PLL tone decoder IC

BA1604/BA1604F

The BA1604 and BA1604F are tone decoder ICs that enable the frequency to be selected in precise detail, using a PLL system. These ICs are configured of a PLL circuit, a detection circuit, a voltage comparator circuit and an output logic drive circuit.

When the input signal is within the transmission range of the circuit, PLL is synchronized (locked) to the input signal. At this point, the output voltage of the decoder drops, and the change turns on the transistors for the voltage comparator and output logic drive circuits. A load of up to 100mA can be driven.The center frequency (f_0) of the decoder is set by the mobile oscillation frequency of the current control oscillator. This frequency is determined by selecting a CR connected to Pins 5 and 6.

●Applications

Telephones

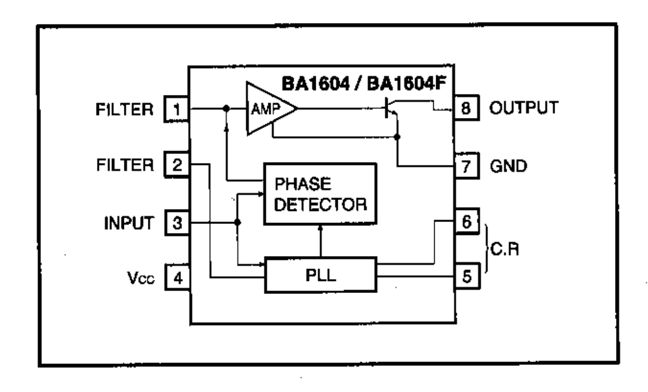
Data communication systems

Remote control systems

●Features

1) The detection bandwidth can be varied independently between 0 and 14%.
2) The output circuit can withstand a load current of up to 100mA, and is directly coupled to the logic circuit.
3) The center frequency offers a high level of stability.
4) High out-of-band signal and noise rejection capability.
5) Frequency can be changed over a range of 20 : 1 using an external resistor.
6) Compatible with EXAR XR-567 and Signetics NE567.

●Block diagram



● Absolute maximum ratings (Ta=25℃)

Parameter		Symbol	Limits	Unit
Power supply voltage		V_{CC}	9	V
Power dissipation	BA1604	Pd	300 *1	mW
	BA1604F		350 *2	
Operating temperature		Topr	−10~75	℃
Storage temperature		Tstg	−55~125	℃

*1 Reduced by 3 mW for each increase in Ta of 1°C over 25°C.
*2 Reduced by 3.5 mW for each increase in Ta of 1°C over 25°C.

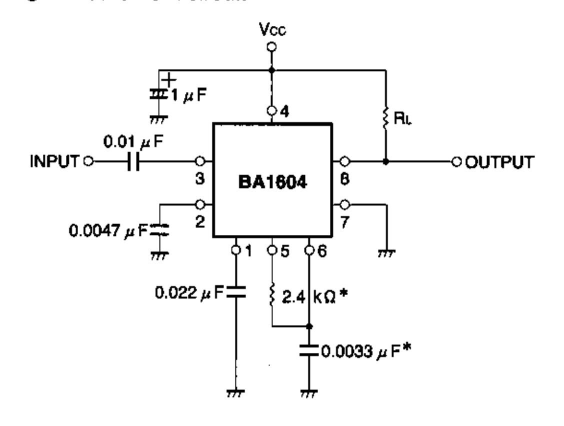
● Recommended operating conditions (Ta=25℃)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	V_{CC}	4.75	6.0	9.0	V

● Electrical characteristics (Unless otherwise noted, Ta=25℃, V_{CC}=5V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Quiescent current 1	I_{Q-1}	−	6.0	10	mA	R_L=20kΩ, detector OFF
Quiescent current 2	I_{Q-2}	−	10	15	mA	R_L=20kΩ, detector ON
Output voltage	V_{OUT}	−	−	15	V	−
Input voltage	V_{IN}	−10	−	V_{CC}+0.5	V	−
Frequency stability	Δf_{oT}	−	±60	−	ppm / ℃	−
Frequency stability	Δf_{oV}	−	0.5	2.0	% / V	−
Maximum detection bandwidth	$W_{Max.}$	10	14	18	% of f_o	f_o=100kHz
Maximum detection bandwidth skew	$\Delta W_{Max.}$	−	−	3	% of f_o	−
Change in maximum detection bandwidth	ΔW_t	−	±0.1	−	% / ℃	V_{IN}=300mV_{rms}
Change in maximum detection bandwidth	ΔW_V	−	±2	−	% / V	V_{IN}=300mV_{rms}
Input resistance	R_{IN}	−	20	−	kΩ	−
Minimum input voltage at detector ON	D_{ON}	−	20	25	mV_{rms}	I_L=100mA, f_i=f_o
Maximum input voltage at detector OFF	D_{OFF}	10	15	−	mV_{rms}	I_L=100mA, f_i=f_o
2-signal selection ratio	V_{IR}	−	6	−	dB	In-band/out-of-band signals
Minimum input signal-to-wide-band noise ratio	R	−	6	−	dB	B_n=140kHz
Output saturation voltage 1	V_{sat-1}	−	0.2	0.4	V	I_L=30mA, V_{IN}=25mV_{rms}
Output saturation voltage 2	V_{sat-2}	−	0.6	1.0	V	I_L=100mA, V_{IN}=25mV_{rms}
Output leakage current	I_L	−	0.01	25	μA	−
Maximum ON-OFF cycle	$T_{Max.}$	−	f_o/ 20	−	−	−
Output rise time	t_H	−	150	−	ns	R_L=50Ω
Output fall time	t_L	−	30	−	ns	R_L=50Ω

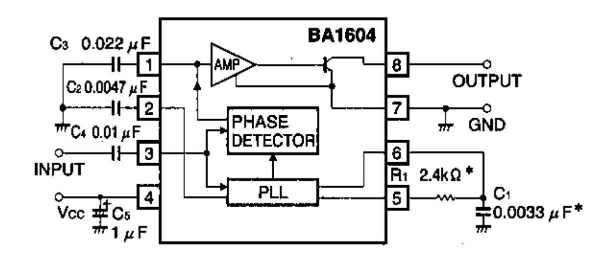
●Measurement circuit



* Fine adjustment should be done until f_0 = 100 kHz

Fig. 1

●Application example



* C_1 and R_1 should be adjusted until f_0 = 100 kHz

Fig. 2

●Electing external circuit components

(1) C_1 and R_1 : Setting f_0

The center frequency (f_0) is determined by the resistor R_1 between Pins 5 and 6, and the capacitor C_1 between Pin 6 and the ground. The constants at this point are determined as follows :

$$f_0 \fallingdotseq \frac{1}{C_1R_1} \text{ (kHz) (C : } \mu\text{F, R : k}\Omega\text{)}$$

A rectangular-wave voltage is output at Pin 5; the peak-to-peak amplitude is between Vcc and 1.4 V, and the average DC value is Vcc / 2. This pin can drive a load resistance of up to 1kΩ. (The recommended value for R_1, however, is from 2kΩ to 20kΩ.)

A 1V peak-to-peak exponential function triangular wave with an average DC voltage level of Vcc/2 is output at Pin 6. Since loading this pin adversely affects both the duty cycle and the temperature stability of the oscillator, it must only be connected to a high-impedance load.

(2) C_2 : Loop filter

Connected between Pin 2 and the ground, C_2 functions as a low pass filter for the PLL circuit, and the time constant is determined by $T_2 = R_2C_2$ (R_2 is the internal impedance for Pin 2, at 10 kΩ). The value of C_2 also determines the detection bandwidth. The voltage at Pin 2 varies linearly at 20mV / % of f_0 over the range 0.95 f_0 to 1.05 f_0.

(3) C_3 : Output filter

Capacitor C_3, connected between Pin 1 and the ground, is used as a low pass filter to suppress out-of-band signals. The time constant T_3 is determined by $T_3 = R_3C_3$ (R_3 is the internal impedance for Pin 1, at 4.7kΩ).

To prevent false detection of spurious signals, it is recommended that $C_3 \geqq 2 \times C_2$. If C_3 is made too large, however, this will increase the time required for voltage changes at Pin 1 to reach the threshold of the phase detector, thus slowing the response time.

(4) C_4 : Input coupling capacitor

(5) C_5 : Power supply filter capacitor

●Input and output pins

(1) Input : Pin 3

The input signal is applied through a coupling capacitor to Pin 3. Internal circuits set this pin to a DC potential of 2V with respect to the ground. The input impedance is approximately 20kΩ.

(2) Output : Pin 8

The output logic section has an internal power transistor with its collector connected to Pin 8. The load is connected between Pin 8 and Vcc. The transistor saturates when an in-band input signal is received, dropping the potential at Pin 8 to less than 1V (0.6V Typ.). The output can also drive a load connected to a separate supply voltage of up to 20V.

●Electrical characteristic curves

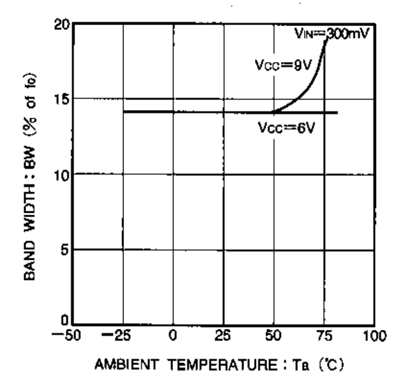


Fig. 3 Detection bandwidth vs. ambient temperature characteristic

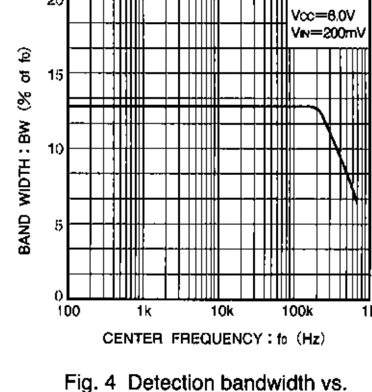


Fig. 4 Detection bandwidth vs. frequency characteristic

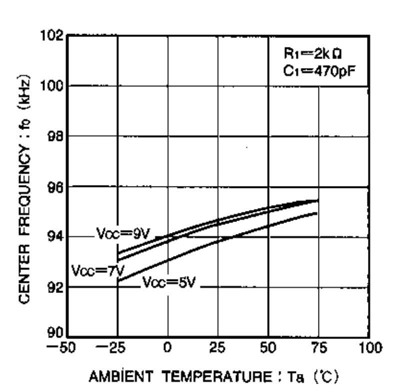


Fig. 5 Center frequency vs. ambient temperature characteristic

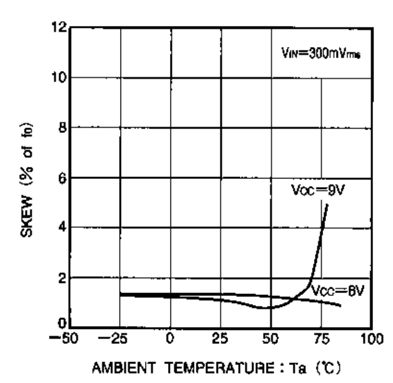


Fig. 6 Detection bandwidth skew vs. ambient temperature characteristic

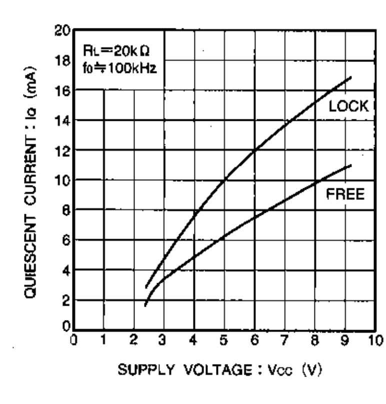


Fig. 7 Quiescent current vs. supply voltage characteristic

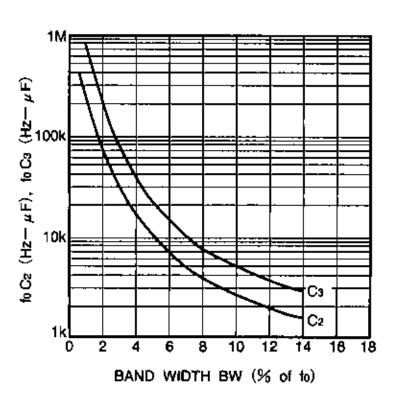


Fig. 8 Detection bandwidth based on C_2 and C_3

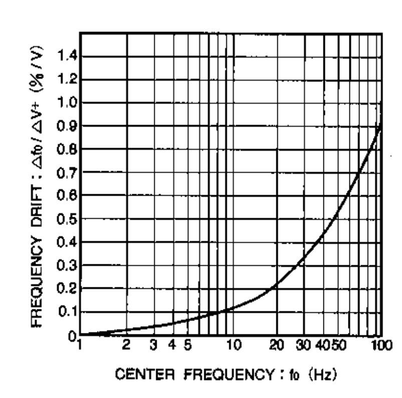


Fig. 9 Center frequency fluctuation based on power supply voltage vs. center frequency characteristic

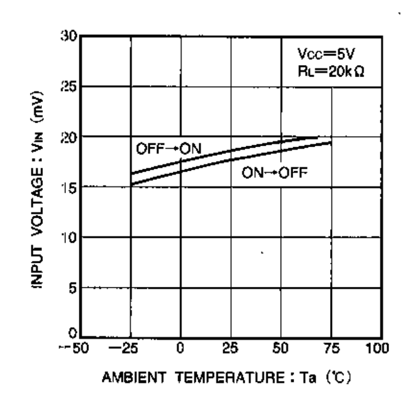
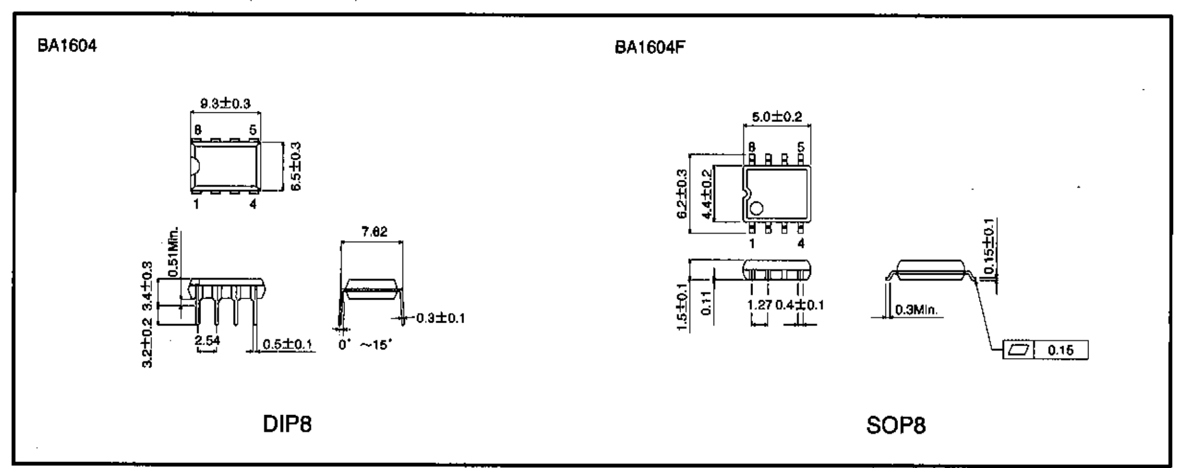


Fig. 10 Detector input sensitivity vs. ambient temperature characteristic

●External dimensions (Units: mm)



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